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(54) ELECTROMAGNETIC SOLENOID RELAY ASSEMBLY AND ELECTRICAL CONNECTION MEANS THEREFOR

(71) We, ESSEX GROUP, INC., a Corporation organised and existing under the laws of the State of Michigan, United States of America, having a place of business at 1601 Wall Street, Fort Wayne, Indiana 46804, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement: —

In the prior art, solenoid type relays are known which are adapted to be fastened to a printed circuit board and in which two movable plunger armatures carry their respective contacts into engagement when the coil is energized. Also known in the prior art is a solenoid relay in which a contact carried on the pole face of a stationary core member mates with a contact carried by a movable armature. In this solenoid relay structure, a spring disc supports and biases the armature for movement toward and away from the stationary core.

It is also known in the prior art to use a spring clip to secure a relay or other device on a printed circuit board.

Because printed circuits have generally been used in situations where space is a prime consideration, electromagnetic relays have not widely been mounted on printed circuits because of their size. Small relays have been developed specifically for the purpose of mounting on printed circuit boards. However, these relays suffer from the drawback that their current carrying capacity is somewhat less than desirable or the printed circuit board mounting is complicated and/or unreliable.

According to the invention there is provided an electromagnetic solenoid relay assembly comprising:

an electromagnetic coil assembly including a spool-like bobbin having a bore extending axially therethrough, first and second end flanges on said bobbin, and an electromagnetic coil wound upon said bobbin; a stationary core member occupying a first end of said bore and secured to said bobbin; a movable armature core member slidably located in said bore for movement toward and away from said stationary core member; co-operating electrical contacts on the opposing faces of said stationary and movable cores; an insulative plate attached to said second end flange, said plate having a plurality of spaced apart electrical terminals located thereon; spring means for biasing said movable core away from said stationary core; electrically conductive means for electrically connecting the contact on said stationary core member with one of the electrical terminals on said insulative plate; said spring means being electrically connected to another one of the electrical terminals on said insulative plate; electrically conductive means connecting said spring means with the electrical contact on said movable core member; and the leads of said electromagnetic coil being connected to electrical terminals on said insulative plate.

An example of the invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a longitudinal cross sectional view of a solenoid type relay of the present invention;

Figure 2 is an end elevational view of the solenoid relay of Figure 1 with the casting removed;

Figure 3 is an elevational view of the other end of the solenoid relay of Figure 1;

Figure 4 is a cross sectional view taken alone lines 4-4 of Figure 3;

Figure 5 is a top elevational view of the relay assembly of the invention mounted on a printed circuit board; and

Figure 6 is a front elevational view of the relay-printed circuit board assembly of Figure 5.

Figure 1 shows a solenoid type relay including an electromagnetic coil assembly 10, a magnetic core assembly 12, an electrical connector assembly 14, and a casing 15.

The electromagnetic coil assembly 10 includes a spool-like bobbin 16 which has a central tubular portion 18 and circular end flanges 20, 22 attached to opposite ends of tubular portion 18. The bobbin 16 forms a holder for a plurality of turns 24 of magnet type wire.

The magnetic core assembly includes a stationary core 26 situated in the right end of bore 28 in tubular portion 18. The interior end of stationary core member 26 is tapered outwardly as at 30. An electrical contact member including an integral head 32 and shaft 34 is situated with shaft 34 occupying an axial bore 36 in stationary core member 26. Stationary core 26 is prevented from moving axially into bore 28 by a tab 37 which cooperates with a corresponding notch 38 in end flange 22. Shaft 34 extends through an aperture in a flat strip electrical conductor 40 and its end is peened over. The electrical conductor 40 performs the twofold function of maintaining stationary core member 26 in place and making an electrical connection to the electrical contact head 32. It will be seen that electrical conductor 40 includes a portion 40*a* which lies flat against flange 22 and which is mechanically and electrically attached to shaft 34, portion 40*b* which extends longitudinally along the outside of electromagnetic coil assembly 10 and portion 40*c* which extends along flange 20 generally parallel to portion 40*a*.

The magnetic core assembly 12 also includes a movable armature core member 42 situated in bore 28 for slidable movement toward and away from the stationary core member 26. The interior end of movable core member is tapered at 44 so as to complement the taper 30 on core member 26. An electrical contact member including an integral head 46 and shaft 48 is attached to core member 42 with head 46 located so as to contact the head 32. A leaf spring member 50 is attached to movable core member 42 by peening over the end of shaft 48. The leaf spring 50 serves the dual function of biasing movable core 42 away from the stationary core 26 and making an electrical connection to electrical contact 46.

The electrical connector assembly 14 includes a rigid insulative plate 52 which is attached to flange 20. Preferably, the plate 52 is attached to flange 20 by frictional means such as plurality of tabs 54 spaced around the periphery thereof which frictionally engage the flange 20 or electrical conductor 40. However, it will be appreciated by those skilled in the art that the plate 52 may be attached to the flange 20 by any suitable means. Plate 52 has a plurality of spaced apart, electrically conductive, resilient pads or terminals 56, 58, 60, 62*a* and 62*b* located therein. Each electrically conductive pad comprises a molded, resilient, compressible, dielectric substance, such as silicone rubber, and throughout which a plurality of discrete, electrically conductive particles are dispersed. The size and quantity of the particles are such that they may establish electrically conductive paths through the pads. The pads 56. 58, 60, 62*a* and 62*b* are thicker than plate 52 so as to project beyond the sides of the latter and are either bonded after molding to the edges of the openings in the plate 52 or are adhered thereto by being molded in situ. The structural and electrical characteristics of the pads and the manner in which they are formed are disclosed in U.S. Patent Specification No. 3,648,002 to which reference may be had for a more detailed description.

It will be appreciated that since plate 52 is clipped onto flange 20, electrically conductive pad 58 makes electrical contact with portion 40*c* of conductor 40, conductive pad 60 makes electrical contact with portion 50*b* of leaf spring 50, and conductive pad 56 makes electrical contact to the peened over end of shaft 48 through an aperture 64 in spring portion 50*b* (only when movable core member 42 is in the deenergized position).

The plate 52 also cooperates with the bobbin flange 20 in such a manner as to provide a mounting for the leaf spring 50. An aperture 66 in leg 50*a* of leaf spring 50 fits over a boss 68 on flange 20 and the end 70 of leaf spring 50 is entrapped between an inwardly extending flange 72 on plate 52 and an outwardly extending flange 74 on flange 20. Boss 68 also serves to entrap the end of spring leg 50*b* between it and resilient contact 60.

Referring now to Figure 4, electrical connections to the electromagnetic coil leads (not shown) are made through resilient terminals 62*a* and 62*b* which abut against the head of contact pins 76*a* and 76*b* respectively. Contact pins 76*a* and 76*b* each include a shaft portion which is frictionally engaged in an aperture in the end flange 20. The contact pins 76*a* and 76*b* each also include: an intermediate portion 78*a* and 78*b*, and a head 80*a* and 80*b*, respectively. Surrounding the intermediate portions 78*a* and 78*b* and located between the contact pin head and the portion of flange 20 thereunder is a resilient compres-

sible, electrically conductive washer 82*a*, 82*b* formed of similar or the same material as contact pads 56, 58, 60, 62*a* and 62*b*. With the construction shown in Figure 4, the electromagnetic coil leads are stripped of electrical insulation, are placed around the intermediate portions 78*a*, 78*b* along with the contact washers 82*a*, 82*b* and the contact pins are inserted and retained in the apertures in flange 20. With the plate 52 is assembled to the bobbin flange 20, it will be appreciated that contact pads 62*a* and 62*b* will make electrical contact with the heads 80*a*, 80*b* of contact pins and, of course, the electromagnetic coil leads which are electrically connected to the contact pins.

The casing 15 is generally cup shaped metal member inside which the solenoid type relay assembly is situated. Preferably, the casing frictionally engages the outer periphery of the plate member 52 and/or the periphery of the electromagnetic coil assembly.

Referring now to Figures 5 and 6, the solenoid relay assembly is shown in position mounted on a printed circuit board 84. The printed circuit board 84 has a plurality of spaced apart electrically conductive strips 86*a*, 86*b*, 86*c*, 86*d* and 86*e* which are arranged in such a manner that they terminate in a pattern identical to the pattern of the electrically conductive pads 56, 58, 60, 62*a* and 62*b* on the pressure plate. In mounting the solenoid relay assembly on the printed circuit board, electrically conductive pad 56 is placed in face-to-face contact with conductive strip 86*e*, conductive pads 58 and 60 make face-to-face electrical contact with conductive strips 86*a* and 86*c*, and conductive pads 62*a* and 62*b* make face-to-face electrical contact with conductive strips 86*b* and 86*d*.

Casing member 15 has two parallel ribs 88 formed in the end thereof which define an indentation therebetween and which provides a locating position for a spring clip 90. Spring clip 90 includes an arcuate spring portion 92 and mounting legs 94 and 96 which are adapted to extend through apertures in the printed circuit board. The ends 98 and 100 of mounting legs 94, 96, respectively, are bent over to permanently attach the relay to the printed circuit board.

It will be appreciated by those skilled in the art that the above-described relay structure is compact, and thus, is particularly adaptable to mounting on printed circuits. Further, by mounting the main electrical contacts on the core members in the high density flux field, the magnetic blowout effect is utilized to its greatest advantage in such a manner to increase the current carrying capability.

Of course, obvious modifications will occur to those skilled in the art. One such modification which is contemplated by the present invention is replacing the main current carrying contacts (which in the preferred embodiment of the invention are formed from conventional contact material) with contacts of similar material to the ones located on the plate 52.

WHAT WE CLAIM IS:—

1. An electromagnetic solenoid relay assembly comprising:

an electromagnetic coil assembly including a spool-like bobbin having a bore extending axially therethrough, first and second end flanges on said bobbin, and an electromagnetic coil wound upon said bobbin;

a stationary core member occupying a first end of said bore and secured to said bobbin;

a movable armature core member slidably located in said bore for movement toward and away from said stationary core member;

co-operating electrical contacts on the opposing faces of said stationary and movable cores;

an insulative plate attached to said second end flange, said plate having a plurality of spaced apart electrical terminals located thereon;

spring means for biasing said movable core away from said stationary core;

electrically conductive means for electrically connecting the contact on said stationary core member with one of the electrical terminals on said insulative plate;

said spring means being electrically connected to another one of the electrical terminals on said insulative plate;

electrically conductive means connecting said spring means with the electrical contact on said movable core member; and

the leads of said electromagnetic coil being connected to electrical terminals on said insultative plate.

2. The relay assembly as claimed in claim 1, wherein;

said spaced apart electrical terminals on said insulative plate each comprise a resilient, deformable elastomeric pad having a plurality of discrete electrically conductive particles dispersed therein, said pad extending through said plate slightly beyond the faces thereof.

3. The relay assembly as claimed in claim 1 or claim 2 wherein said electrically conductive means for electrically connecting the contact on said stationary core member with one of the electrical terminals on said insulative plate comprises:

an electrically conductive shaft integral with said contact and extending axially through said stationary core;

a strip-like electrical conductor connected to said shaft, said strip-like electrical conductor extending around said electromagnetic coil assembly, the free end of said strip-like electrical conductor being entrapped between said one of said electrical terminals and said second end flange.

4. The relay assembly as claimed in any one of claims 1 to 3 wherein said electrically conductive means connecting said spring means with the electrical contact on said movable core member comprises:

an electrically conductive shaft integral with said contact and extending axially through said movable core member;

said conductive shaft being secured to said spring means.

5. An electromagnetic solenoid relay assembly substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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1521447 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

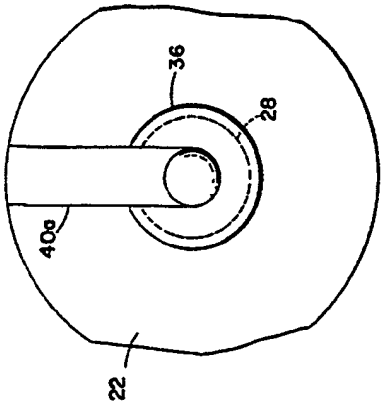

FIG 2

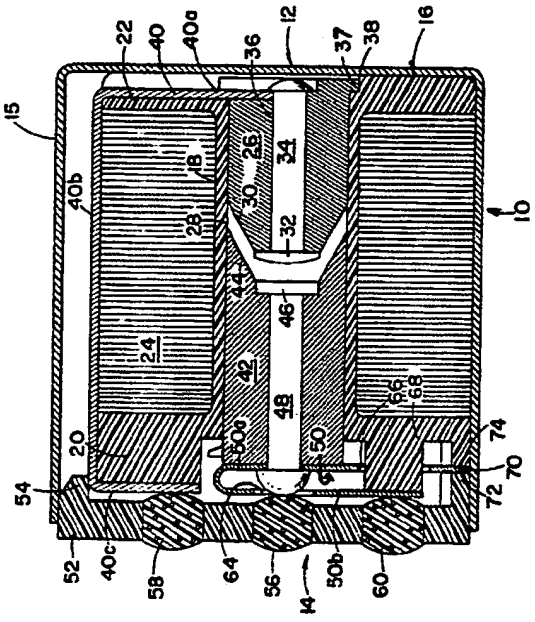

FIG 1

1521447 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 2

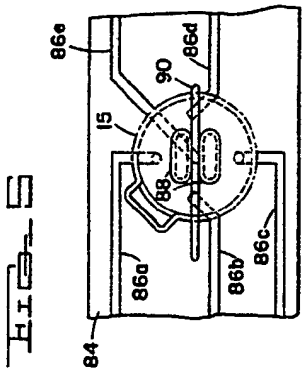

FIG. 5

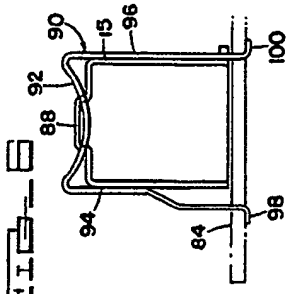

FIG. 6

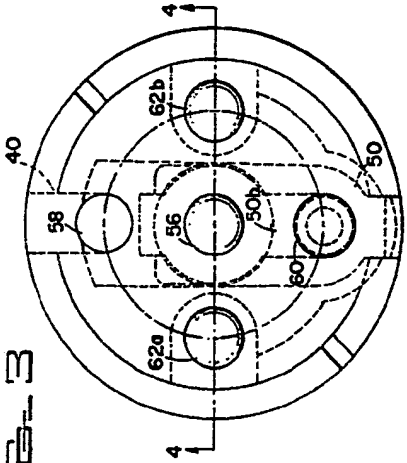

FIG. 3

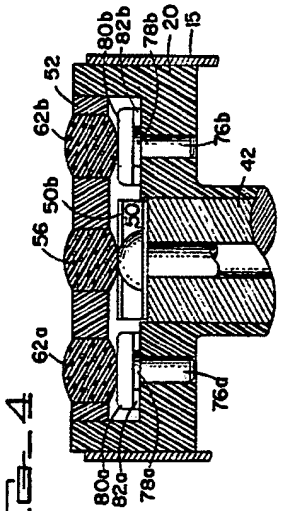

FIG. 4